

### 3.8 ROCKY FLATS ENVIRONMENTAL TECHNOLOGY SITE

Rocky Flats Environmental Technology Site was established in 1952 by the AEC and is located in rural northern Jefferson County, Colorado, 26 km (16 mi) northwest of downtown Denver and about 19 km (12 mi) south of Boulder. Once a remote site, RFETS is now adjacent to a large and growing metropolitan area that includes the communities of Boulder, Arvada, Westminster, Broomfield, and Golden. The Rocky Flats Industrial Area occupies approximately 155 ha (384 acres) in the middle of the site. The remaining 2,495 ha (6,165 acres) form a buffer zone around the active part of RFETS. The buffer zone provides a distance of more than 1.6 km (1 mi) between the developed portion of the site and any public road or private property.

The RFETS mission is to transition from a production-dominated site to an environmental restoration, cleanup, and waste management-dominated site. The contingency status of buildings that could have been used to manufacture new Pu components has been removed. The site will retain a Pu storage mission pending decisions and actions regarding long-term Pu storage and disposition based on this PEIS. The DOE property boundaries for the site are illustrated in Figure 2.2.7-1. The locations of major Pu facilities at RFETS are shown in Figure 2.2.7-2. Current activities at RFETS are all related to DOE activities. RFETS missions are listed in Table 3.8-1.

**Table 3.8-1. Current Missions at Rocky Flats Environmental Technology Site**

<b>Mission</b>	<b>Description</b>	<b>Sponsor</b>
Interim Pu storage	Maintain Buildings 371, 559, 707, 776/777, and 771 for interim Pu storage, with eventual consolidation into a single facility.	Assistant Secretary for Environmental Management
RFETS environmental restoration and waste management	As buildings are released from DP control, decontaminate and decommission; remove all Pu and other toxic and/or hazardous materials; prepare Pu wastes for final transport to long-term storage facility.	Assistant Secretary for Environmental Management

Source: RFETS 1995a:1.

**Department of Energy Activities.** With the January 1992 Presidential decision to cancel W88 warhead production, there are currently no weapons-related Pu operations scheduled for RFETS. The site will continue its Pu storage function, employing existing buildings for nonsurplus and surplus Pu materials. Pu component fabrication and production support activities have been permanently stopped; any such future activities would take place at other DOE sites. Other RFETS DOE activities that have been relocated under the nonnuclear manufacturing consolidation include the following:

- Manufacturing, fabrication, and repair support for the safe secure tractors, trailers, and railcars of the DOE transportation safeguards activities
- Fabrication of nuclear weapon component and assembly training devices, used by both DOE and the DoD
- Reservoir production that involves fabricating, assembling, testing, inspecting, and shipping of gas reservoir assemblies
- Metrology services
- Nuclear-grade steel

The expected reduction in stockpile requirements would have allowed Pu recovered from retired weapons to be recycled for all new production needs. Current stockpile projections anticipate that larger quantities of Pu will

be returned from weapon disassembly activities. Consequently, all existing residues, wastes, and Pu oxides do not need to be reprocessed for future weapon production at this time. These materials would only be processed to the extent necessary to ensure their stability for long-term monitored, retrievable storage or transport off the RFETS site in a Pu metal or oxide form. Selection of disposition options for residues would be based on minimizing waste disposal costs.

The current RFETS long-term mission is to prepare Pu processing and fabrication facilities for D&D with final disposition by EM. The Pu storage mission involves materials designated as either strategic reserve for current or anticipated program needs, surplus that can be converted to stable metal or oxide forms for storage and transport, or residue that is destined for disposal as waste. Pu storage capabilities would be maintained in Buildings 371, 707, 771, 776/777, and 559, with eventual consolidation into a single facility.

While preparing for PEIS ROD implementation, this interim period without Pu processing will permit operating selected RFETS Pu processing facilities to support the environmental restoration mission. Individual buildings and facilities will be D&D in accordance with EM plans.

The primary mission of RFETS was to produce components for nuclear weapons from materials such as Pu, uranium, beryllium, and various alloys of stainless steel. Production was stopped in 1989, and up until that time plant operations and purposes were kept secret, with little mission and management information given to the public. The site was off-limits to the general public. In 1992, the plant's production of nuclear weapon components was officially discontinued with the end of the Cold War.

Rocky Flats Environmental Technology Site now has a new mission focusing on environmental restoration, waste management, management of special nuclear materials onsite (one of which is Pu), D&D of facilities, and economic development. Although the site remains off-limits to the general public due to health and safety considerations, DOE now provides extensive information to the public concerning management and operations and works closely with the public on many issues related to RFETS.

**Non-Department of Energy Activities.** The RFETS has no non-DOE activities at this time.

### **3.8.1 LAND RESOURCES**

**Land Use.** The 2,650-ha (6,550-acre) RFETS is located in northern Jefferson County, Colorado, approximately 26 km (16 mi) northwest of downtown Denver. All land within RFETS is owned by the Federal Government and is administered, managed, and controlled by DOE.

*Existing Land Use.* Generalized land uses within RFETS and the immediate vicinity are shown in Figure 3.8.1-1. Land uses surrounding the site are primarily open space, industrial, and rural residential and agricultural (grazing and hay production) (RF EG&G 1993a:2-1). RFETS contains two major categories of land use: industrial and undeveloped. Production facilities occupy approximately 155 ha (384 acres), or 6 percent of the site, and are centrally located on the site (RF DOE 1994a:2). The approximately 2,495 ha (6,165 acres) that remains is utilized as a security buffer zone while most of this area is open space (undeveloped); however, there are several other uses, including approximately 8 ha (20 acres) of production support facilities, approximately 45 ha (111 acres) of sanitary waste disposal, and 211 ha (523 acres) of aggregate and clay mining. No prime farmland exists onsite. There are no public recreation facilities onsite.

*Land-Use Planning.* Planning does not occur at the state level within Colorado, however, regional planning within the RFETS vicinity occurs through advisory Denver Regional Council of Governments (DRCOG). RFETS is located within Jefferson County, one of six counties that comprise the DRCOG. Jefferson County does not currently have a countywide comprehensive plan, however, the county has adopted community plans. Community plans function as land-use plans for specific areas of the county and their recommendations are used for making and granting future land-use decisions. The North Plains Community Plan designates RFETS as a "Special Use Area." The zoning resolution for Jefferson County classifies RFETS land with the following zoning districts: agricultural, industrial, and special use.

**Visual Resources.** The RFETS lays amid a landscape that is mostly grazing land with low hills and ridges. Construction and operation of the DOE facilities has heavily disturbed the character of the landscape. The most dominant features of the site include two large stacks and a water tank. The existing facilities are separated from public roads by the open land in the buffer area. The Rocky Mountains start to rise approximately 3.2 km (2 mi) to the west of RFETS. Because access to the site is limited to authorized personnel, public visual access is limited to views from the outside (RF EG&G 1993a:3-22). The facilities are brightly lit at night and are highly visible from many areas within a 4.8- to 8-km (3- to 5-mi) radius of the site. The area within the central developed area is consistent with a VRM Class 5 designation. The remainder of the site ranges from VRM Class 3 to Class 4.

### 3.8.2 SITE INFRASTRUCTURE

**Baseline Characteristics.** Activities at RFETS are concentrated in facilities in the middle of the site. To support these activities, an extensive infrastructure exists. Baseline site infrastructure characteristics are shown in Table 3.8.2-1.

*Table 3.8.2-1. Rocky Flats Environmental Technology Site Baseline Characteristics*

Characteristics	Current Usage	Site Availability
<b>Transportation</b>		
Roads (km)	40	40
Railroads (km)	5	5
<b>Electrical</b>		
Energy consumption (MWh/yr)	184,000	184,000
Peak Load (MWe)	26	26
<b>Fuel</b>		
Natural gas (m <sup>3</sup> /yr)	18,600,000	18,600,000
Oil (l/yr)	8,140,000	8,140,000
Coal (t/yr)	0	0
<b>Steam (kg/hr)</b>	41,000	41,000

Source: RFETS 1995a:1.

Two-lane county and State highways circumvent the site and include State Route 93 to the west, State Route 128 to the north, and Indiana Street to the east. No roads exist along the southern boundary and no public access roads traverse the site. RFETS has controlled access gates to the east and west with a paved road running through the middle of the site connecting Route 93 to Indiana Street. The site also has numerous dirt firebreak and access roads for management. Nuclear wastes from RFETS are transported by truck primarily along the interstate highway system. Nuclear shipments are restricted to off-peak periods when traffic activity is low.

Normal and alternate power is supplied from the Public Service Company of Colorado through two electrical switching stations. Currently, one station (to the north of the site) is used for primary services, and the other (just outside the west gate) is used to supply a small portion of the western side of the site and as backup electrical power. Emergency diesel generators provide backup power capabilities should normal and alternate power be lost. The sub-regional electric power pool from which RFETS draws its power is the Rocky Mountain Power Area. Capabilities of this power pool are summarized in Table 3.8.2-2.

The site is connected to a Public Service Company natural gas line. The line passes through the site and continues west to serve residential customers in the Coal Creek canyon area.

There are two methods by which the site acquires water; the method used at any particular time is at the discretion of the Denver Water Board. The preferred supply comes from a diversionary canal between Gross and Ralston Reservoirs. The canal passes the site between the west gate and Route 93, and provides gravity-fed flow to a holding pond, also to the west of the site. The second method involves pumping water directly from Ralston Reservoir to the holding pond, overcoming more than 300 ft of head pressure.

**Table 3.8.2–2. Rocky Mountain Area Sub-Regional Power Pool Electrical Summary**

Characteristics	Energy Production
<b>Type Fuel</b>	
Coal	71%
Nuclear	0%
Hydro/geothermal	15%
Oil/gas	5%
Other <sup>a</sup>	9%
<b>Total Annual Production</b>	52,781,000 MWh
<b>Total Annual Load</b>	49,936,000 MWh
<b>Energy Exported Annually<sup>b</sup></b>	2,753,000 MWh
<b>Generating Capacity</b>	10,691 MWe
<b>Peak Demand</b>	7,861 MWe
<b>Capacity Margin<sup>c</sup></b>	2,357 MWe

<sup>a</sup> Includes power from both utility and nonutility sources.

<sup>b</sup> Energy exported is not the difference of production and load due to negative net pumped storage.

<sup>c</sup> Capacity margin is the amount of generating capacity available to provide for scheduled maintenance, emergency outages, system operating requirements, and unforeseen electrical demand.

Source: NERC 1993a.

The locations of buildings at RFETS are shown in Figure 2.2.7–2; the buildings that play a role in the site EA's proposed Category I and II special nuclear material consolidation and interim storage program are highlighted. Buildings 371 and 707 would play the most active role in the proposed site-specific action while Buildings 771, 776/777, 779, and 991 would perform consolidation support functions. The remainder of this section provides a description of these buildings. With the exception of Building 371, all of the buildings were built to commercial industrial standards. Building 371 was built to strict nuclear design standards.

Building 371 currently stores Category I and II special nuclear material and is proposed to be the primary special nuclear material consolidation and interim storage facility until long-term storage and disposition actions are decided and implemented. Portions of the RFETS Pu residues, TRU waste, and RCRA waste inventories currently are stored in Building 371. The four-level facility has approximately 17,300 m<sup>2</sup> (186,000 ft<sup>2</sup>) of floor space and contains six Pu storage vaults and vault-type rooms. The stacker/retriever moves radioactive materials between the central storage vault and the input and output stations. In addition to this transport capability, the central storage vault was designed for storage of Category I and II special nuclear material.

Building 707 is a two-story facility with 6,897 m<sup>2</sup> (74,240 ft<sup>2</sup>) per floor. A single-story portion with 1,724 m<sup>2</sup> (18,560 ft<sup>2</sup>) composes the east side of the building. The building contains 10 modules in which various manufacturing activities have taken place in the past. Building 707 is connected directly, through other buildings or by tunnels, to Buildings 776/777, 771, 778, and 779.

Building 771 is a two-level facility with approximately 14,000 m<sup>2</sup> (151,000 ft<sup>2</sup>) of floor space and stores Pu that requires stabilization. The building is connected by a tunnel to Building 776/777, which is directly connected to Buildings 779 and 707. The tunnel between Buildings 771 and 776 is concrete-lined and is equipped with a HEPA filtration ventilation system.

Building 776/777 is a two-story facility with approximately 14,500 m<sup>2</sup> (156,200 ft<sup>2</sup>) of floor space and contains special nuclear material that requires stabilization. The building is connected to Building 779 by an enclosed hallway, to Building 771 by tunnel, and to Building 707 via Building 778.

Building 779 is a research and development facility originally built to support production and recovery processes. The facility was completed in 1965, and the external structure was subsequently improved to withstand an earthquake of 6.0 on the Richter scale.

Building 991 was built in 1952 and is used primarily for shipping special nuclear material and other certified product materials (including nonnuclear materials). The facility and its associated underground tunnels and vaults are also used for storing special nuclear material and other certified product materials.

### 3.8.3 AIR QUALITY AND NOISE

**Meteorology and Climatology.** The RFETS region is characterized as a dry climate, middle-latitude steppe, with mild, sunny, semiarid conditions and few temperature extremes. The average annual temperature at RFETS is 10.2 °C (50.3 °F); temperatures vary from an average daily minimum of -8.8 °C (16.1 °F) in January to an average daily maximum of 31.2 °C (88.2 °F) in July. The average annual precipitation at RFETS is 39.1 cm (15.4 in). The average annual windspeed at Denver National Weather Service Station is 3.8 m/s (8.6 mph) (NOAA 1994a:3). Additional information related to meteorology and climatology at RFETS is presented in Appendix F.

**Ambient Air Quality.** The RFETS is located within the Metropolitan Denver Intrastate AQCR #36. This AQCR is designated nonattainment with respect to the NAAQS for PM<sub>10</sub>, O<sub>3</sub>, and CO, and listed as attainment for SO<sub>2</sub> and NO<sub>2</sub> (40 CFR 81.306). The PM<sub>10</sub> standard is exceeded primarily due to fugitive dust. Vehicular traffic is a major contributor to the high concentrations of O<sub>3</sub> and CO in the region. Applicable NAAQS and the ambient air quality standards for Colorado are presented in Appendix F.

Since the creation of the PSD program in 1977, PSD permits have not been required for any new RFETS emission sources. There are several PSD (40 CFR 52.21) Class I areas near RFETS. The closest, Rocky Mountain National Park, is located approximately 46 km (30 mi) northwest of RFETS.

The emissions inventory from sources at RFETS is presented in Appendix F. Historically the principal sources of criteria pollutants at RFETS are the steam plant boilers. Minor combustion sources include various small boilers and diesel generators. Other sources of criteria pollutants include coating operations and particulate matter from various manufacturing operations.

National hazardous and toxic air pollutant standards have not been adopted by the State of Colorado Department of Public Health and Environment. The annual emission rates of hazardous/toxic air pollutants from existing RFETS facilities for the period 1991 through 1993 are listed in Appendix F.

Table 3.8.3-1 presents the baseline ambient air concentration for criteria pollutants and other pollutants of concern at RFETS. As shown in the table, baseline concentrations are in compliance with applicable guidelines and regulations.

**Noise.** Major noise sources at RFETS include various facilities, equipment, and machines (for example, cooling systems, transformers, engines, pumps, boilers, steam vents, paging systems, construction and materials-handling equipment, and vehicles). No sound-level measurements have been made around RFETS to determine background sound levels. Most RFETS industrial facilities are at a sufficient distance from the site boundary to make noise levels at the boundary from these sources barely distinguishable from background noise.

The acoustic environment along the RFETS boundary and at nearby residences away from traffic noise is typical of a rural location or quiet suburban residential area, with DNL in the range of 35 to 52 dBA (EPA 1974a:B-4). Traffic is the primary source of noise at the site boundary and at nearby residences. Plant traffic contributes little to overall traffic noise. However, traffic noise is expected to dominate sound levels along major roads in the area. Except for the prohibition of nuisance noise, neither the State of Colorado nor its local governments have established environmental noise standards applicable to RFETS.

**Table 3.8.3-1. Comparison of Baseline Ambient Air Concentrations With Most Stringent Applicable Regulations or Guidelines at Rocky Flats Environmental Technology Site, 1991-1994**

Pollutant	Averaging Time	Most Stringent Regulations or Guidelines <sup>a</sup> ( $\mu\text{g}/\text{m}^3$ )	Baseline Concentration <sup>b</sup> ( $\mu\text{g}/\text{m}^3$ )
<b>Criteria Pollutants</b>			
Carbon monoxide	8-hour	10,000 <sup>c</sup>	145
	1-hour	40,000 <sup>c</sup>	534
Lead	Calendar Quarter	1.5 <sup>c</sup>	<sup>d</sup>
	30-day	1.5 <sup>e</sup>	<sup>d</sup>
Nitrogen dioxide	Annual	100 <sup>c</sup>	4.14
Ozone	1-hour	160 <sup>e</sup>	<sup>f</sup>
Particulate matter less than or equal to 10 microns in diameter	Annual	50 <sup>c</sup>	0.235
	24-hour	150 <sup>c</sup>	17.4
Sulfur dioxide	Annual	80 <sup>c</sup>	0.295
	24-hour	365 <sup>c</sup>	21.8
	3-hour	700 <sup>e</sup>	64.6
<b>Mandated by the State of Colorado</b>			
Hydrogen sulfide	1-hour	142 <sup>e</sup>	<0.01
Total suspended particulates	Annual	75 <sup>e</sup>	0.284
	24-hour	150 <sup>e</sup>	21.0
<b>Hazardous and Other Toxic Compounds</b>			
1,1,2-Trichloro-1,2,2 Trifluoroethane	Annual	<sup>g</sup>	0.01
Carbon tetrachloride	Annual	<sup>g</sup>	0.01
Diethyl phthalate	Annual	<sup>g</sup>	<0.01
Methylene chloride	Annual	<sup>g</sup>	<0.01
Nitric acid	Annual	<sup>g</sup>	<0.01
Trichloroethane	Annual	<sup>g</sup>	<0.01

<sup>a</sup> The more stringent of the Federal and State standard is presented if both exist for the averaging time.

<sup>b</sup> Modeled concentration based on permit data.

<sup>c</sup> Federal and State standard.

<sup>d</sup> Data not available from the source document.

<sup>e</sup> State standard.

<sup>f</sup> Ozone, as a criteria pollutant, is not directly emitted or monitored by the site. See Section 4.1.3 for a discussion of ozone-related issues.

<sup>g</sup> No State standard for indicated averaging time.

Source: 40 CFR 50; CO DPHE 1994a; RFETS 1995a:1.



### 3.8.4 WATER RESOURCES

**Surface Water.** The main surface water features at RFETS are Walnut Creek, North Walnut Creek, South Walnut Creek, and Woman Creek (Figure 3.8.4-1). The streams at RFETS are considered part of the Big Dry Creek drainage basin, although Big Dry Creek is not directly affected by RFETS activities. Rock Creek flows through the northwestern portion of the site and is physically separate from the operational plant complex; as such, Rock Creek is unaffected by site activities. Rock Creek has been maintained in an undisturbed condition since 1952.

The RFETS lies on the divide between Walnut Creek and Woman Creek drainage basins. North Walnut Creek and South Walnut Creek drain the central and northern areas of RFETS, and Woman Creek drains the southern areas. The confluence of South and North Walnut Creeks forms Walnut Creek. Walnut Creek flows downstream from RFETS and empties into the Broomfield Diversion Ditch. The Broomfield Diversion Ditch routes water around the Great Western Reservoir, which is a public water supply, then into Big Dry Creek, and eventually into the South Platte River.

Woman Creek flows east across the southern portion of RFETS into Standley Lake, which provides irrigation storage and municipal water for surrounding communities. Woman Creek may also be diverted into Mower Reservoir which also flows into Standley Lake. Standley Lake flows into Big Dry Creek, which flows into the South Platte River.

All natural surface water flow on RFETS occurs in ephemeral channels that flow only as a result of precipitation, discharge of site effluents, surface seeps, or release of water from storage areas west of the site to supplement water supplies in the Great Western Reservoir or Standley Lake. On North Walnut Creek, South Walnut Creek, and Woman Creek, a series of unlined ponds serve to impound waters from the site. Along North Walnut Creek, the ponds are numbered A-1 through A-4; on South Walnut Creek, the ponds are numbered B-1 through B-5; and on Woman Creek, the ponds are numbered C-1 and C-2. Pond C-2 is off channel from Woman Creek and does not receive direct flow. Flow into Pond C-2 is from runoff into South Interception Ditch and then into Pond C-2.

Wastewater from industrial processes is treated at a treatment plant that is isolated from other sources and does not discharge to surface water features. Existing sanitary wastewater generation is estimated at approximately 150 million l/yr (39.6 million gal/yr). Sanitary wastewater is treated and discharged to Pond B-3. Stormwater runoff from the plant is conveyed in storm sewers that discharge to creeks on the undeveloped portion of the site. Discharges from Ponds A-3, A-4, B-3, B-5 and C-2 are monitored under the NPDES-permit program.

Terminal ponds (A-4, B-5, and C-2) are designed to capture the flow from a 100-year storm if maintained at less than 10 percent of capacity. However, RFETS has been unable to maintain the 10-percent capacity limit due to the treatment of large quantities of water and delays in receiving approval for certain discharges.

The primary source of flood potential at RFETS is from flash flooding in seasonal streams. Of these, Woman Creek and North and South Walnut Creek drain the part of the site occupied by plant facilities. A recent study evaluating flooding potential at RFETS indicated that even in the most extreme circumstances it is unlikely that flows on Woman Creek could pose a hazard to facilities. The stream is at least 24 m (79 ft) below the elevation of structures in proximity to the stream (LLNL 1988a:3-1). Because evidence suggested that Walnut Creek may be subject to excessive flows during periods of high rainfall and runoff, a probabilistic flood analysis was performed. The 500-year floodplain of Walnut Creek corresponds to an elevation of approximately 1,806 m (5,925 ft). The majority of RFETS facilities are located between elevations of 1,814 and 1,844 m (5,952 and 6,050 ft) mean sea level. Therefore, these facilities lie outside the 500-year floodplain.

The RFETS does not withdraw any water from streams on or near the site. All water for the plant is obtained from surface waters from the city of Denver via the South Boulder Diversion Canal from the South Boulder Creek and

Ralston Reservoir. The water supply contract with the city and county of Denver through the Denver Water Board is for an unguaranteed supply of up to 5.7 million l/day (1.5 million gal/day). The current average water consumption is approximately 485 million l/yr (128 million gal/yr). Raw water is stored in a 5.7 million l (1.5 million gal) storage pond west of the plant.

**Surface Water Quality.** The water from Woman Creek, North Walnut Creek, and South Walnut Creek flows into ponds that restrict offsite discharges and allow water testing and, if necessary, treatment to meet water quality standards. A treatment facility is located at Pond A-4. Water from Pond B-5 is transferred to Pond A-4. Treatment consists of filtration and carbon absorption to reduce potential radionuclides and organic chemical contaminants. With concurrence from the Colorado Department of Health, water is released from Pond A-4 to Walnut Creek, and from Pond C-2 to the Broomfield Diversion Ditch, or in an emergency, to Ponds A-4 or B-5.

Discharges from Ponds A-4 and B-5 enter Walnut Creek and are diverted around the Great Western Reservoir by the Broomfield Diversion Ditch. Water is discharged untreated from Pond C-2 through a 2,438 m (7,999 ft) pipeline into the Broomfield Diversion Ditch and around the Great Western Reservoir. The release of untreated discharge from Pond C-2 has been approved by EPA because sampling indicates that the discharge meets all Woman Creek standards except for gross beta. The gross beta standards for Walnut Creek, the eventual destination of the piped discharge are higher, and no standard is exceeded.

An unlined surface water control pond exists immediately downstream and downgradient of the landfill and current waste disposal operations at the eastern end of the landfill. The landfill is considered a hazardous waste management landfill due to past disposal of some materials that may now qualify as regulated hazardous wastes. The landfill pond routinely exceeds the RFETS standard for strontium and has exceeded standards for copper, iron, lithium, manganese, mercury, nickel, Pu, and zinc. The landfill pond does not discharge to natural surface waters.

Water quality monitoring results for Walnut Creek and Woman Creek are presented in Table 3.8.4-1. These results indicate that concentrations were less than the water quality criteria listed. No Notices of Violations were received by RFETS in 1993 for NPDES limitations.

**Surface Water Rights and Permits.** Surface water rights are not an issue at RFETS because RFETS facilities do not withdraw surface water for use. As previously mentioned, the water supply contract with the city and county of Denver is for an unguaranteed supply of up to 5.7 million l/day (1.5 million gal/day).

**Groundwater.** Two nonhydraulically connected groundwater systems are present at RFETS. The upper unit exists as an unconfined aquifer and the lower unit as a confined aquifer. The contact separating the two units is identified as the base of the weathered zone.

The unconfined aquifer at RFETS is primarily unconsolidated alluvial material. The average depth to the water table in the unconsolidated surficial deposits range from about 21 m (70 ft) at the western boundary of RFETS to less than 3 m (10 ft) in the industrial area. Seeps are common along stream drainage. Groundwater flow direction is generally toward the east. Recharge to the unconfined aquifer occurs from infiltration of precipitation and as seepage from ditches, creeks, and ponds. In addition, retention ponds along South Walnut and Woman Creeks probably recharge this unit.

In the confined aquifer, groundwater is in the sandstone lenses below most of the plant. Flow within the sandstones is assumed to be from west to east. In some places, the sandstones are in contact with the alluvium so that the unit is part of the unconfined system at those places. Recharge to the sandstones occurs where they are in direct contact with the alluvium and valley fill of the upper aquifer or by leakage through claystones in contact with alluvium. The sandstone units discharge along the South Platte River, about 47 km (29 mi) east of RFETS.

**Table 3.8.4-1. Summary of Surface Water Quality Monitoring at Rocky Flats Environmental Technology Site, 1993**

Parameter	Unit of Measure	Water Quality Criteria and Standards <sup>a</sup>	Existing Water Body Concentration	
			Average	Maximum
Receiving Water: Walnut Creek				
Alpha (gross)	pCi/l	11 <sup>b</sup>	2.4	2.9
Americium-241	pCi/l	0.05 <sup>b</sup>	0.001	0.013
Beryllium	mg/l	0.004 <sup>c</sup>	<0.001	<0.001
Beta (gross)	pCi/l	19 <sup>b</sup>	2.0	3.0
Copper	mg/l	1.0 <sup>d</sup>	0.008	0.010
Lead	mg/l	0.015 <sup>c</sup>	<0.002	<0.047
Plutonium-239/240	pCi/l	1.2 <sup>e</sup>	0.002	0.024
Total dissolved solids	mg/l	500 <sup>d</sup>	325	350
Tritium	pCi/l	500 <sup>b</sup>	0	250
Uranium-233/234	pCi/l	10 <sup>b</sup>	0.65	1.00
Uranium-238	pCi/l	10 <sup>b</sup>	0.69	1.17
Receiving Water: Woman Creek				
Americium-241	pCi/l	0.05 <sup>b</sup>	0.017	0.017
Beryllium	mg/l	0.004 <sup>c</sup>	<0.001	<0.001
Copper	mg/l	1.0 <sup>d</sup>	0.004	0.004
Lead	mg/l	0.015 <sup>c</sup>	<0.050	<0.050
Plutonium-239/240	pCi/l	1.2 <sup>e</sup>	0.010	0.010
Total dissolved solids	mg/l	500 <sup>d</sup>	328	328
Tritium	pCi/l	500 <sup>b</sup>	67	110
Uranium-233/234	pCi/l	5 <sup>b</sup>	2.74	2.74
Uranium-235	pCi/l	5 <sup>b</sup>	0.08	0.08
Uranium-238	pCi/l	5 <sup>b</sup>	2.32	2.32

<sup>a</sup> For comparison purposes only, except for parameters that have Colorado State Water Quality Standards.  
[Text deleted.]

<sup>b</sup> Colorado State Water Quality Standards, specific for Walnut and Woman Creeks.

<sup>c</sup> National Primary Drinking Water Regulations (40 CFR 141).

<sup>d</sup> National Secondary Drinking Water Regulations (40 CFR 143).

<sup>e</sup> DOE DCG for water (DOE Order 5400.5). DCG values are based on a committed effective dose of 100 mrem per year; however, because the drinking water maximum contaminant level is based on 4 mrem per year, the number listed is 4 percent of the DCG.

Source: RFETS 1994a.

**Groundwater Quality.** Groundwater monitoring has been conducted at RFETS since 1960. By the end of 1994, about 300 wells were monitored for the purpose of determining groundwater quality and to determine the distribution of contaminant constituents in groundwater at RFETS. Groundwater quality in uncontaminated portions in surficial materials (alluvium, colluvium, valley fill, and weathered bedrock) is relatively good and can be classified as calcium bicarbonate water. The unweathered bedrock groundwater system can be distinguished from the surficial system by relatively higher sodium and sulfate content. Background groundwater quality for the upper and lower hydrostratigraphic units beneath RFETS is summarized in Table 3.8.4-2.

The unconfined aquifer contains both radiological and nonradiological contaminants. To date, the understanding of the hydrogeologic relationships indicate that there are no known bedrock pathways through which

**Table 3.8.4–2. Groundwater Quality Monitoring at Rocky Flats Environmental Technology Site, 1994**

Parameter	Unit of Measure	Water Quality Criteria and Standards <sup>a</sup>	Existing Conditions	
			Upper Hydrostatic Unit	Lower Hydrostatic Unit
Alpha (gross)	pCi/l	15 <sup>b</sup>	8.354	3.127
Americium-241	pCi/l	1.2 <sup>c</sup>	0.011	0.028
Beryllium	mg/l	0.004 <sup>b</sup>	0.00222	0.00204
Beta (gross)	pCi/l	50 <sup>d</sup>	4.892	3.234
Cadmium	mg/l	0.005 <sup>b</sup>	0.00245	0.00240
Cesium-137	pCi/l	120 <sup>c</sup>	0.420	0.217
Chloride	mg/l	250 <sup>e</sup>	12.8	100.108
Copper	mg/l	1.0 <sup>e</sup>	0.01085	0.00970
Lead	mg/l	0.015 <sup>b</sup>	0.00855	0.00272
pH	pH Units	6.5–8.5 <sup>e</sup>	7.14	7.85
Radium-226	pCi/l	5 <sup>b</sup>	0.258	1.723
Strontium-89/90	pCi/l	800 <sup>c</sup> /400 <sup>c</sup>	0.338	0.473
Sulfate	mg/l	250 <sup>e</sup>	86.230	123.943
Total dissolved solids	mg/l	500 <sup>e</sup>	354.151	545.138
Tritium	pCi/l	80,000 <sup>c</sup>	101.702	56.881
Uranium-233/234	pCi/l	20 <sup>c</sup>	6.914	1.643
Uranium-235	pCi/l	24 <sup>c</sup>	0.195	0.033
Uranium-238	pCi/l	24 <sup>c</sup>	4.832	0.768

<sup>a</sup> For comparison purposes only.<sup>b</sup> National Primary Drinking Water Regulations (40 CFR 141).<sup>c</sup> DOE DCG for Water (DOE Order 5400.5). DCG values are based on a committed effective dose of 100 mrem per year; however, because the drinking water maximum contaminant level is based on 4 mrem per year, the number listed is 4 percent of the DCG.<sup>d</sup> Proposed National Drinking Water Regulations; Radionuclides (56 FR 33050).<sup>e</sup> National Secondary Drinking Water Regulations (40 CFR 143).

Source: RFETS 1995a:3.

groundwater contamination can directly leave RFETS and migrate into the confined aquifer system offsite (RFETS 1994a:123).

There are five principle areas where groundwater has been affected by plant activities at RFETS (Figure 3.8.4–2). The first plume is associated with the solar evaporation ponds, which were used to store radioactive/hazardous waste. The main contamination from this plume surrounds 207A and 207B ponds. Groundwater flow data across the solar evaporation ponds area diverges along two flow paths. One flow path is northeasterly toward North Walnut Creek and the other is southeasterly toward South Walnut Creek. Groundwater quality data from 1993 indicate that the solar ponds contributed nitrate/nitrite, sodium, TDSs, fluoride, bicarbonate, sulfate, dissolved radionuclides, several dissolved metals, and VOCs to the groundwater in surficial material and weathered bedrock immediately north, east, and southeast of the ponds (RFETS 1994a:130). The radionuclides include tritium, Pu-239, -240, Americium-241, and U-233, -234, -235, and -238.

The second plume, the 903 Pad, Mound, and Trench plume, is located in the southeastern-central portion of RFETS. The 903 Pad and Mound areas were historically used for storage and burial, respectively, of radioactively contaminated wastes. The plume located in the upper hydrostratigraphic unit is contaminated with

VOCs, inorganics, dissolved metals, and some radionuclides (RFETS 1994a:127). The plume does not lie beneath buildings that house DOE activities.

The third plume is associated with the present landfill and is located at the western end of an unnamed drainage channel which discharges to North Walnut Creek. [Text deleted.] The plume contains inorganic analytes, dissolved metals, dissolved radionuclides, and VOCs, as well as nitrate and nitrite above standard levels (RFETS 1994a:136). The plume does not lie beneath buildings that house DOE activities.

The fourth plume is the 881 Hillside plume, located in the south-central portion of RFETS in the shallow groundwater system. Based on the most recently completed Phase III remedial investigation, VOCs (that is, carbon tetrachloride, perchloroethylene, and trichloroethylene) pose the most public health risk (RFETS 1994a:127). This area was used for the storage of drums containing cleaning solvents from 1967 to 1972. The plume also contains elevated levels of total dissolved solids, metals (nickel, Sr, selenium, zinc, and copper), and uranium. The plume does not lie beneath any buildings housing DOE activities.

The fifth plume is associated with the Western Industrial Area, with primary contamination occurring in the western portion of the RFETS buffer zone. Within and adjacent to the Western Industrial Area, groundwater quality has been impacted by carbon tetrachloride, tetrachloroethene, and trichloroethene. This plume does not lie beneath buildings that house DOE activities.

*Groundwater Availability, Use, and Rights.* Currently, no groundwater is used for potable purposes by the facility. However, approximately 10.6 million l/yr (2.8 million gal/yr) of groundwater is withdrawn from the site as part of the environmental restoration program, for contaminant removal.

In general, the rights to groundwater resources in Colorado are unrelated to ownership of the land under which those groundwater resources are located. However, for the Denver Basin aquifers, which include the lower aquifers at the RFETS, the right to groundwater resources derives from land ownership as long as the water is not tributary to any surface water supplies.

### **3.8.5 GEOLOGY AND SOILS**

**Geology.** The RFETS is located on the western edge of the Colorado Piedmont section of the Great Plains physiographic province. The site is located on the west flank of the Denver Basin, an extensive sedimentary basin bordered on the west by the base of the Colorado Front Range. The site is located on a geomorphic surface comprised of a gravel-capped pediment surface identified as the Rocky Flats alluvial surface.

The surficial geology at RFETS consists of Quaternary alluvial, colluvial, eolian, and landslide deposits that range in thickness from several centimeters to over 30.5 m (100 ft). The most important unit is the Rocky Flats Alluvium, which consists of poorly sorted deposits of sand, gravel, and cobbles in a clay matrix that thins from west to east across the site (RF DOE 1985a:21). The Arapahoe Formation (Cretaceous-age), which immediately underlies the Rocky Flats Alluvium at RFETS, is approximately 0 to 36.5 m (0 to 120 ft) thick and consists of fluvial claystones with interbedded lenticular sandstones and siltstones (RF DOE 1985a:20; RF EG&G 1994a:G-1,G-2).

The RFETS lies in Seismic Zone 1, indicating minor damage could occur as a result of earthquakes (Figure 3.2.5-1). Occasional earthquakes with MMI of V to VI occur in Colorado. No major faults cut the Arapahoe Formation or overlying alluvium in the vicinity of RFETS (RF DOE 1985a:20). The Livingston fault, located approximately 5 km (3 mi) to the west, and the Golden fault, located approximately 8 km (5 mi) to the south, are the mountain-front faults closest to the facility. Neither fault is recognized as a capable fault according to 10 CFR 100, Appendix A. No other capable faults are present in the immediate vicinity of RFETS. There are no known areas of active volcanism in the Denver Basin.

Landslides and other mass earth movements are present as shallow features where slopes are steep. Nearly all of the site, however, has slopes averaging only 2 percent. Slopes may be greater than 2 percent along the sides of washes.

**Soils.** The RFETS is underlain mainly by soils of the Denver-Kutch and Flatirons-Velscamp soil associations. Erosion potential of the Denver-Kutch soil is low to moderate and shrink-swell potential is moderate to high. The Flatirons-Velscamp soil does not pose an erosion hazard, and its shrink-swell potential is low to moderate.

### 3.8.6 BIOLOGICAL RESOURCES

**Terrestrial Resources.** The RFETS is located at an elevation of 1,829 m (6,000 ft) above sea level, at the approximate elevation where plains grassland vegetation meets lower montane forest (RF DOE 1980a:2-93). Plant facilities occupy about 6 percent of the total site area. Vegetative communities on RFETS have been divided into four basic types; those within the central portion of the site are shown on Figure 3.8.6-1. Plant communities include grassland, marshland, woodland, and shrubland. Grassland is the most common community onsite, with mesic and zeric grasslands being the predominant subtypes. Marshland occurs along several creeks that traverse the site. Woodlands and shrublands are not common communities on RFETS. Habitats that are considered important to wildlife (especially waterfowl and passerine birds) include riparian zones along creeks and trees on south facing slopes (RFP 1992b:3). A total of 362 species of vascular plants have been identified on the site (RF DOE 1991i:23).

It appears that vegetation is recovering from the grazing that occurred before Government acquisition of the land. Recent studies have indicated that plant succession has progressed since the 1970s. Most areas formerly mapped as annual weed communities now qualify as perennial grassland. Indicator species for perennial grassland such as western wheatgrass and Canada bluegrass have increased in abundance and now dominate over much of the site (RF DOE 1991i:4).

Animals identified on the RFETS include 4 amphibian, 8 reptile, 167 bird, and 36 mammal species (RF DOE 1995a:2). Common animals of the site include the common bullsnake, prairie rattlesnake, western meadowlark, mourning dove, coyote, and mule deer (RF DOE 1991i:4,5,23,24). A variety of game animals occur on the site; however, hunting is not permitted. Numerous raptors, such as the red-tailed hawk and rough-legged hawk, and carnivores, such as the coyote and long-tailed weasel, are found on RFETS. Migratory birds and their nests and eggs are protected by the *Migratory Bird Treaty Act*. Eagles are similarly protected by the *Bald and Golden Eagle Protection Act*.

**Wetlands.** Rocky Flats Environmental Technology Site contains a variety of wetlands including intermittent streams, ditches, ponds, and hillside seeps. Most wetlands that occur onsite are found along ephemeral streams and are classified on NWI maps as palustrine. There are several manmade wetlands on the site including vegetated sections of ditches, such as the South Interceptor Ditch, the A, B, and C-series ponds, and the landfill pond. Wetlands also occur at various locations around the site that are fed by drains and stormwater from paved areas and other surface runoff (RFP 1991c:4). Numerous seeps are scattered on the hillsides of the site. Vegetation typical of wetlands at RFETS includes sandbar willow, American watercress, plains cottonwood, broad-leaf cattail, and bulrush. In total there are about 43 ha (107 acres) of aerial wetlands and 25.9 km (16.1 mi) of narrow wetlands along streambeds within RFETS (RF DOE 1990b:18,19,22).

**Aquatic Resources.** Aquatic habitat on RFETS consists of ephemeral streams, ditches, ponds, and springs. Four streams flow within the site boundaries; North Walnut Creek, South Walnut Creek, Woman Creek, and Rock Creek (Figure 3.8.4-1). Each of these streams supports a series of on-channel retention reservoirs or ponds which collect surface water runoff and wastewater. North and South Walnut Creek, which are located in the northeast portion of the site, flow eastward offsite and into Great Western Reservoir. Fathead minnows are found in these streams. There are three holding ponds along North Walnut Creek and four ponds along South Walnut Creek. These ponds support crayfish and various other macroinvertebrates; fathead minnows are found in at least one of the ponds (RF DOE 1980a:2-96).

Woman Creek, which is located in the southern portion of the site, flows eastward offsite and into Standley Lake. Seven species of fish have been identified in Woman Creek and include several minnows, largemouth bass, green sunfish, and the white sucker (RF DOE 1991b:4). Redside dace and bluegill occur in holding ponds located along Woman Creek (RF DOE 1980a:2-97).

Rock Creek is located in the northwest portion of the site and is unlikely to support a large number of fish. However, Lindsay Pond, located on Rock Creek, does provide habitat for redbreasted sunfish and largemouth bass (RF DOE 1980a:2-96).

Ditches located on RFETS convey stormwater runoff to holding ponds. These ditches do not support any fish populations. There are several permanent and temporary ponds located throughout the site, and a number of springs are found in the southwest portion of the site. Information is not available on the aquatic organisms found in these habitats (RFP 1992b:4).

**Threatened and Endangered Species.** The 35 federally and State-listed threatened, endangered, and other special-status species that may be found on or in the vicinity of the RFETS area are listed in Table 3.8.6-1. Twelve of these species have been observed on or in close proximity to the site. Potential suitable habitat for the remaining 23 species exists on RFETS. No critical habitat for threatened or endangered species, as defined in the ESA (50 CFR 17.11; 50 CFR 17.12), exists on RFETS.

**Table 3.8.6-1. Federally and State-Listed Threatened, Endangered, and Other Special Status Species That May Be Found on or in the Vicinity of Rocky Flats Environmental Technology Site**

Common Name	Scientific Name	Status <sup>a</sup>	
		Federal	State
Mammals			
[Text deleted.]			
Preble's meadow jumping mouse <sup>b</sup>	<i>Zapus hudsonius preblei</i>	NL	SC
[Text deleted.]			
Spotted bat	<i>Euderma maculatum</i>	NL	U
Swift fox	<i>Vulpes velox</i>	C	U
Birds			
American peregrine falcon <sup>b,c</sup>	<i>Falco peregrinus anatum</i>	E	T
American white pelican <sup>b</sup>	<i>Pelecanus erythrorhynchos</i>	NL	SC
Arctic peregrine falcon <sup>c</sup>	<i>Falco peregrinus tundrius</i>	E (S/A)	T
[Text deleted.]			
Bald eagle <sup>b,c</sup>	<i>Haliaeetus leucocephalus</i>	T	T
Barrow's goldeneye	<i>Bucephala islandica</i>	NL	SC
[Text deleted.]			
Black-throated gray warbler <sup>b</sup>	<i>Dendroica nigrescens</i>	NL	SC
Blue grosbeak <sup>b</sup>	<i>Guiraca caerulea</i>	NL	SC
Ferruginous hawk <sup>b</sup>	<i>Buteo regalis</i>	NL	SC
Greater sandhill crane <sup>b</sup>	<i>Grus canadensis tibida</i>	NL	T
Least tern <sup>c</sup>	<i>Sterna antillarum</i>	E	E
[Text deleted.]			
Long-billed curlew <sup>b</sup>	<i>Numenius americanus</i>	NL	SC
Mountain plover	<i>Charadrius montanus</i>	C	SC
[Text deleted.]			
Piping plover <sup>c</sup>	<i>Charadrius melodus</i>	T	T
Plains sharp-tailed grouse	<i>Tympanuchus phasianellus jamesi</i>	NL	E
Southwestern willow flycatcher	<i>Empidonax traillii extimus</i>	E	NL
Western burrowing owl <sup>b</sup>	<i>Athene cunicularia hypugea</i>	NL	U



**Table 3.8.6–1. Federally and State-Listed Threatened, Endangered, and Other Special Status Species That May Be Found on or in the Vicinity of Rocky Flats Environmental Technology Site—Continued**

Common Name	Scientific Name	Status <sup>a</sup>	
		Federal	State
Western snowy plover	<i>Charadrius alexandrinus nivosus</i>	NL	SC
White-faced ibis	<i>Plegadis chihi</i>	NL	U
Whooping crane <sup>c</sup>	<i>Grus americana</i>	E	E
[Text deleted.]			
<b>Fish</b>			
Common shiner	<i>Notropis cornutus</i>	NL	SC
[Text deleted.]			
Stonecat	<i>Noturus flavus</i>	NL	SC
<b>Plants</b>			
Adder's mouth orchid	<i>Malaxis brachypoda</i>	NL	SC
Bell's twinpod	<i>Physaria bellii</i>	NL	SC
Black spleenwort	<i>Asplenium adiantum-nigrum</i>	NL	SC
Colorado butterfly plant	<i>Guara neomexicana coloradensis</i>	C	SC
Forktip three-awn <sup>b</sup>	<i>Aristida basiramea</i>	NL	SC
Gay-feather	<i>Liatris ligulistylus</i>	NL	SC
Sedge <sup>b</sup>	<i>Carex oreocharis</i>	NL	SC
Toothcup	<i>Rotala ramosior</i>	NL	SC
Tulip gentian	<i>Eustoma grandiflora</i>	NL	SC
Ute ladies'-tresses	<i>Spiranthes diluvialis</i>	T	SC
Yellow stargrass	<i>Hypoxis hirsuta</i>	NL	SC

<sup>a</sup> Status codes: C=Federal candidate; E=endangered; NL=not listed; S/A=protected under the similarity of appearance provision of the *Endangered Species Act*; SC=State species of concern; T=threatened; U=State undetermined species.

<sup>b</sup> Species observed on RFETS.

<sup>c</sup> USFWS Recovery Plan exists for this species.

Source: 50 CFR 17.11; 50 CFR 17.12; CO NHP 1994a; RF DOE 1995d.

Three federally listed threatened or endangered species (the bald eagle, peregrine falcon [both subspecies], and Ute ladies'-tresses) occur or are likely to occur on the RFETS site. Bald eagles have been observed flying over and occasionally foraging on RFETS and are known to roost at Standley Lake and Great Western Reservoir, approximately 1.8 km (1.1 mi) and less than 0.5 km (0.3 mi), respectively, from the site. Peregrine falcons have been observed flying over and hunting onsite. Two historical nest sites are within 16 km (10 mi) of the site. Ute ladies'-tresses are known to occur approximately 12.9 km (8 mi) north of the site in Boulder County (RF DOE 1995a:2,3). Suitable habitat exists on RFETS for this species, but no specimens were found during site surveys. Although the complex of prairie dog towns on the site provides suitable habitat for the endangered black-footed ferret, occurrence of the ferret is highly unlikely (RF DOE 1991j:5), and the area has been cleared of the requirement for verifying surveys.

[Text deleted.] The State-listed greater sandhill crane and several other special status species have been observed on RFETS. Continued site surveys may determine the occurrence of other special status species listed in Table 3.8.6–1.

### 3.8.7 CULTURAL AND PALEONTOLOGICAL RESOURCES

**Prehistoric Resources.** Three surface examination surveys have been conducted at RFETS resulting in complete coverage of the undisturbed portions of the facility (RF EG&G 1991a:3-2). No prehistoric sites were identified. However, two sites with rock alignments and four isolated cairns were recorded and are most likely prehistoric sites. The two sites have not been evaluated to determine their NRHP eligibility, and these sites are considered potentially NRHP eligible pending additional work. The four isolated features are not considered NRHP eligible. DOE is currently preparing a cultural resources management plan for RFETS to ensure compliance with Sections 106 and 110 of the NHPA.

**Historic Resources.** Thirty-five historic sites have been identified at RFETS. All undisturbed portions of RFETS have been intensively surveyed. Most of the historic resources in the area are archaeological sites or standing structures associated with ranching or transportation routes. Historic site types in the vicinity include trails, railroad grades, homesteads, cattle camps, line shacks, ranch complexes, irrigation ditches, stock ponds, and windmills. Historic sites recorded at RFETS include a railroad grade, stock ponds and tanks, irrigation ditches, corrals, a fence, a dump, a spring house, and homesteads. None of the historic sites or features have been recommended as eligible for the NRHP. There are 123 buildings at RFETS associated with the Cold War mission. Of these, 64 are considered potentially eligible for listing on the NRHP as contributing elements to the Rocky Flats Plant Historic District (RF DOE 1995a:26).

**Native American Resources.** Several Native American groups, including the Plains Apache, Comanche, Ute, Arapaho, and Cheyenne, historically occupied or traversed the foothills around RFETS. Tribal locations have been estimated for the Protohistoric and Historic periods. The Plains Apache occupied the region east of the Rockies prior to 1700. By 1750, the Ute and Comanche were in the area. The Ute moved back into the mountains and the Comanche were located on the Plains by 1820. From 1820 through 1870, the Cheyenne and Arapaho groups were using the area. All of these groups were highly mobile hunters and gatherers whose primary subsistence was based on bison procurement and seasonal plant gathering.

Important sites, such as burial or vision quest locations, may be of concern to Native American groups. Several unidentified rock features and alignments that have been recorded on RFETS may also be of concern to Native American groups. Consultation with the Comanche, Cheyenne, Arapaho, Southern Ute, Mountain Ute, and Apache tribes has been initiated by DOE. Important Native American resources may be identified through consultation with potentially affected groups.

**Paleontological Resources.** Surface geology at RFETS includes Rocky Flats alluvium and Arapahoe sandstone. The Arapahoe sandstone consists of claystone, silty claystones, and sandstones, and is not fossiliferous. Arapahoe sandstone outcrops occur along the edges of Walnut and Woman Creeks. The rest of RFETS is covered by Rocky Flats alluvium, which consists of gravely clays, sands, and gravels. No paleontological materials have been recovered from the RFETS alluvium, and it is considered nonfossiliferous.

### **3.8.8 SOCIOECONOMICS**

Socioeconomic characteristics described for RFETS include employment and regional economy, population and housing, community services, and local transportation. Statistics for employment and regional economy are presented for the REA that encompasses 49 counties around RFETS located in Colorado, Nebraska, and Kansas (Table L.1-1). Statistics for the remaining socioeconomic characteristics are presented for the ROI, a five-county area (located in Colorado) in which 90.6 percent of all RFETS employees reside: Adams County (20 percent), Arapahoe County (3.6 percent), Boulder County (25.6 percent), Denver County (6.2 percent), and Jefferson County (35.2 percent) (Table L.1-8). In 1995, RFETS employed 4,435 persons.

**Regional Economy Characteristics.** Selected employment and regional economy statistics for the RFETS REA are summarized in Figure 3.8.8-1. Between 1980 and 1990, the civilian labor force in the REA increased 39.9 percent to the 1990 level of 1,868,628. The 1994 unemployment in the REA was 4.1 percent, which parallels the unemployment for Colorado. The unemployment for Kansas is about 1 percent higher than that of the REA and Nebraska is about 1 percent lower than the REA unemployment rate. The region's per capita income of \$21,958 in 1993 was approximately 2 percent greater than Colorado's per capita income of \$21,498. Kansas' per capita income (\$19,849) was 9.6 percent lower than the region's, and Nebraska's per capita income (\$19,673) was 10.4 percent lower.

As shown in Figure 3.8.8-1, the composition of the REA economy was similar to that of the statewide economy of Colorado. During 1993, the services sector constituted over 31 percent of the region's total employment followed by retail trade (about 17 percent) and manufacturing (about 9 percent). For Colorado, the service sector accounted for slightly over 30 percent of the total employment, while retail trade accounted for 17 percent and manufacturing, 8 percent. Kansas and Nebraska parallel each other, with the service sector representing 25 and 26 percent of total employment, retail trade representing 17 percent for both States, and manufacturing representing 12 and 10 percent, respectively.

**Population and Housing.** In 1994, the ROI population totaled 1,957,797. From 1980 to 1994, the ROI population grew by 22.9 percent, compared to 26.5 percent for Colorado. Within the ROI, Arapahoe County experienced the greatest population increase, 51.2 percent, while Denver County's population increased by only 0.2 percent. Population and housing trends are summarized in Figure 3.8.8-2.

The increase in number of housing units in the ROI between 1980 and 1990, 22.5 percent, was about 1 percent less than the increase in Colorado housing units. The total number of housing units in the ROI for 1990 was 788,480. The 1990 ROI homeowner and renter vacancy rates, 3.2 and 11.7 percent, respectively, were similar to those in Colorado.

**Community Services.** Education, public safety, and health care characteristics were used to assess the level of community service in the RFETS ROI. Figure 3.8.8-3 presents school district characteristics for the RFETS ROI. Figure 3.8.8-4 summarizes public safety and health care services.

**Education.** In 1994, 18 school districts provided public education services and facilities in the RFETS ROI. As seen in Figure 3.8.8-3, these school districts operated at between 67.5-percent (Denver County School District) and 102.5-percent (Byers School District) capacity. The average student-to-teacher ratio for the RFETS ROI in 1994 was 19:1. The Jefferson County School District had the highest ratio at 23.7:1.

**Public Safety.** City, county, and State law enforcement agencies provided police protection to the residents of the ROI. In 1994, a total of 3,811 sworn police officers were serving the five-county ROI. The city of Denver employed the largest number of officers (1,378) and had the highest officer-to-population ratio (2.8 sworn officers per 1,000 persons). The average ROI officer-to-population ratio was 2.0 officers per 1,000 persons. Figure 3.8.8-4 compares police force strengths across the ROI.

Fire protection services in the RFETS ROI were provided by 5,408 paid and volunteer firefighters in 1995. The fire district with the highest firefighter-to-population ratio was Adams County, with 9.5 firefighters per 1,000 persons, as indicated in Figure 3.8.8-4. Adams County also employed the greatest number of firefighters (1,396). The average firefighter-to-population ratio in the ROI was 2.7 firefighters per 1,000 persons.

**Health Care.** There were 19 hospitals serving the five-county ROI in 1994. Over 64 percent of the hospital bed capacity was located in 9 hospitals in the city of Denver. Figure 3.8.8-4 displays the hospital bed-to-population ratios for the RFETS ROI counties. During 1994, all 19 hospitals operated at below capacity, with bed occupancy rates ranging from 22.4 percent in Adams County to 60.2 percent in Denver County.

There were 5,017 physicians in the ROI during 1994, with the majority (2,649) practicing in Denver County. Figure 3.8.8-4 shows that the physician-to-population ratio ranged from 1.2 physicians per 1,000 persons in Jefferson County to 5.4 physicians per 1,000 persons in Denver County. The average ROI physician-to-population ratio was 2.6 physicians per 1,000 persons.

**Local Transportation.** Vehicular access to RFETS is provided by Colorado State Route 93 to the west and Jefferson County Road 17 (Indiana Street) to the east (see Figure 2.2.7-1 and Figure 2.2.7-2).

Road improvements for segments providing access to RFETS include bridge replacement and reconstruction along Colorado State Route 93 prior to the year 2000. There are no current road improvements that would affect access to RFETS. There is no public transportation to RFETS (RFETS 1995a:4).

Major railroads in the ROI include the Denver and Rio Grande Western Railroad; the Burlington Northern and Santa Fe Railroad; and the Union Pacific Railroad. A single-track spur from the Denver and Rio Grande Western Railroad mainline accesses RFETS from the west. No navigable waterways within the ROI are capable of accommodating waterborne transportation of material shipments to RFETS (DOE 1993j:4-190,4-191). The Denver International Airport, which began operations in 1995, provides passenger and cargo service in the ROI on national and international carriers.